Nanotechnology Materials/Electronics/ Photonics:

Summary of TAG Survey

a presentation to the

President's Council of Advisors on Science and Technology

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Opportunities for Near Term Breakthroughs

- Low cost photovoltaics with 10-yr life
- High intensity lighting and displays
- Advanced biotech “system-on-a-chip” sensors
- Ultra-high-density memory devices
- Advanced materials, customized properties
- Antimicrobial, self-cleaning surfaces
- New filtration systems for viruses and microbes
- Guided self-assembly technology
- High-speed photonic circuits

Opportunities for Long Term Breakthroughs
(with High Probability of Success)

- Custom designed “super” materials
- Nano-energetic materials and fuels
- Moore’s Law driven beyond terabit densities
- Improved efficiency of motors of all types
- New very small high power portable systems
- Quantum information processing
- Low-cost nano-manufacturing
- Reduction of power dissipation
- Low-cost water production
- Small olfactory arrays that exceed sensitivity of dog’s nose
- New classes of biomachines
- Adaptive optics
- Self-healing assemblies and materials
- Smart coatings

Potential Negative Societal Implications

- ➔ Undetectable contamination of human systems
- ➔ Issues related to re-use and disposal
- ➔ Unreasonable expectations
- ➔ Public backlash against imagined consequences
- ➔ Miniaturized weapons that cannot be detected
- ➔ “Creative destruction” of traditional economic sectors
- ➔ Divide between “haves” and “have nots”

What Do We Need to Know More About?

- ➔ Effect of environment on nanosystem behavior
- ➔ Manufacturing techniques
- ➔ Measurement of properties at nanoscale
- ➔ System robustness
- ➔ Bulk processes: friction, viscosity, magnetism
- ➔ Bonding of building blocks at nanoscale
- ➔ Experimental techniques
- ➔ Durability

Major Points or Issues for Future Consideration

- ➔ Electronic platforms for solution phase
- ➔ Educational initiatives
- ➔ Consequences of system behavior
- ➔ Robust manufacturing processes
- ➔ Long term stability
- ➔ Standards

Federal Funding

- ➔ Adequacy: 14 no, 2 yes
- ➔ Poor linkage with national scientific and technology objectives
- ➔ More funding needed for multi-investigator, center type funding
- ➔ Need goals and deadlines – “If U.S. had told scientists to build the atomic bomb without a deadline or appropriate funding, we would still be working on it.”

Federal Funding (cont.)

- Funding needed to encourage industry participation
- Need balanced funding for fundamental and short term
- Be very careful not to over-emphasize short term research goals over long term ones
- Need attention to technology transfer issues

Federal Funding (cont.)

- ➔ Far too few excellent proposals being funded – too many turned down for lack of funding
- ➔ Funding too many diverse programs, not focused
- ➔ Competing nations more focused on commercialization; waiting to capitalize on our developments
- ➔ President Bush should announce a bold new $10B initiative with clear goals and expectations